

## Exploring User Adoption of Augmented Reality Applications based on Pokémon Go

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**Abstract:** Pokémon Go was the first mobile Augmented Reality (AR) game that made it to the top of the download charts of mobile applications. However, very little is known about this new generation of mobile online Augmented Reality (AR) games. Existing media usage and technology acceptance theories provide limited applicability to the understanding of its users. Against this background, this research provides a comprehensive framework that incorporates findings from uses & gratification theory (U&GT), technology acceptance and risk research as well as flow theory. The proposed framework aims at explaining the drivers of attitudinal and intentional reactions, such as continuance in gaming or willingness to conduct in-app purchases. A survey among 642 Pokémon Go players provides insights into the psychological drivers of mobile AR games. Results show that hedonic, emotional and social benefits, and social norms drive, vice versa physical risks (but not privacy risks) hinder consumer reactions. However, the importance of these drivers differs between different forms of user behavior.

**Keywords:** Mobile gaming, Augmented reality, AR, Pokémon Go, Gratifications, Risks, Flow

### 1 Introduction

During the last years, mobile technologies have diffused into all consumer segments [SN13]. Starting with devices for particular tasks (e.g. a cellphone for phone calls), technologies have converged into single devices. Recent technologies and apps aim at linking the real world and the virtual world with each other [Ra15]. Recently, Augmented Reality (AR) apps for mobile devices have entered consumer markets. Broadly speaking, AR is the name of a type of media in which digital information is realistically integrated in the perception of the physical world [SS16]. Without doubt, one of these new and maybe even disruptive markets is AR gaming. Recent AR game launches brought worldwide interest to the opportunities of this type of games – for example, Pokémon Go in 2016. In Pokémon Go, virtual creatures are hidden in real-world locations and players are asked to locate and catch them with their smartphones or other mobile devices. Media have termed Pokémon Go as “the biggest mobile game in U.S. history” [Lo17].

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While AR games are emerging, consumer research in this domain remains scarce [tJ16]. In addition, established theories are limited in applicability to AR games for several reasons. First, most existing technology or media adoption theories do not incorporate AR specific factors. Second, mobile AR games are typically based on a freemium price model, which means downloading and playing the game is for free; however users are able to buy additional features (in-app purchases). Prior research is based on the implicit assumption that these purchases are driven by the same theoretical mechanisms that drive the intention to use a particular app. As we will theorize and empirically show in this research, this assumption is not valid. Third, most existing theories neglect the risks consumers incorporate in their decision-making. Therefore, this research concentrates on the following research questions: (1) What factors drive gamers' intention to play AR games? (2) What factors drive in-app purchases?

To answer these questions, we propose a conceptual model grounded in the literature on media acceptance, which is supplemented by prior research in gaming and AR. The model is then tested among 642 Pokémon Go players and analyzed using structural equation modeling.

## **2 Theoretical Foundation**

### **2.1 Mobile Augmented Reality Games**

According to Craig [Cr13], AR is defined as a “medium in which digital information is overlaid on the physical world that is in both spatial and temporal registration with the physical world and that is interactive in time”. Thus, a user can see the real world, “with virtual objects superimposed upon or composited with the real world”. Thus, in contrast to Virtual Reality (VR), AR is not closed off from reality, but melds the real and virtual worlds together [Ja16].

Pokémon Go is probably the most popular AR game so far. Players have to catch and fight Pokémon while exploring and experiencing the real world. Being an AR application, these virtual creatures appear on a user's device as if they are next to a user's same real-world location. As the game progresses, players are able to train their Pokémon to become more powerful and fight against competing players. Not surprising, public reactions on this game were intense and mixed. While supporters praised the potential to promote physical activity, critics raised various fears, such as accidents, distractions when used while driving, nuisance, and threats to a user's privacy [SV16].

### **2.2 Adoption Theories**

Grounded in communication science, Uses & Gratification Theory (U&GT) addresses the fundamental question of why people use particular media. U&GT proposes that audiences are goal-oriented and proactively selecting media that satisfy particular needs

[Ka73, Ru02]. Although people's needs may vary depending on individual characteristics, they can be classified into five categories [Ka73]: First, cognitive needs, such as information gathering or increasing one's understanding of a particular issue. Second, social integrative needs, which represent the idea that media can help people creating new or maintaining existing relationships – for example, through social media [Ro16]. Third, tension-release needs encompass aspects such as escapism or diversion. Fourth, affective needs include all forms of emotions, pleasure and moods that people want to obtain. Fifth and finally, personal integrative needs describe the idea that people expose certain media to reassure their social status or to gain credibility among others.

U&GT is not without its critics [Ru00], but it remains one of the most widely applied theories in human communication research [Ru02]. Studies have applied and extended U&GT to various contexts, such as mobile social games [WL14]. However, there are only limited studies focusing on the AR-context. Therefore, further research is required in order to fully understand users' determinants to engage with AR [tJ15]. In addition, the importance of the development of a media framework within the mobile AR gaming context is supported by U&GT scholars, such as Ruggiero [Ru00].

### 3 Research Model

As discussed in the previous sections, existing theories are likely to lack of factors to explain consumers' reactions to mobile AR games. Therefore, we propose a new model which is presented on a high level of abstraction in Figure 1. The model proposes that users' evaluation and perception of various benefits, risks and social influences determine users' reactions and intended behaviors.

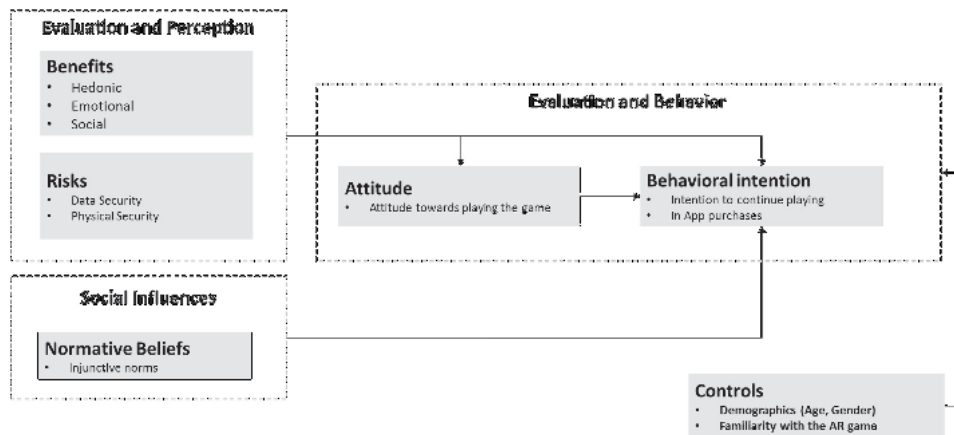


Fig. 1: Model Overview

U&GT provides the foundation for the conceptualization of benefits in the proposed model. As discussed in the theory section on U&GT, people use particular media to satisfy social integrative, tension-related, affective, personal integrative needs, and cognitive needs [Ka73, Ru02]. As AR games are hedonic media that are visibly played in public, we propose that the first four needs are relevant in explaining relevant benefits [Ru02]: social integrative and personal integrative needs are linked to benefits that drive from other people; in our model, we term this category of benefits (syn: gratifications) as ‘social benefits’ covering specific constructs such as image or the management of social relationships. Likewise, tension-related needs are linked to hedonic benefits, and affective needs to emotional benefits. In addition, we propose that risks have a negative effect on users. In this study, we add two risk categories – physical risk and data privacy risk.

### 3.1 Benefits

We propose that three different hedonic benefits are relevant to understand user reactions: Enjoyment, activity, and flow. In the subsequent section, we will outline why and how these factors are proposed to determine consumers’ acceptance of mobile AR games.

We define enjoyment as the extent to which users perceive a mobile AR game as enjoyable [Ve12]. As gaming is associated with enjoyment and enjoyable is generally something that people find positive, we hypothesize:

H1: Enjoyment has a positive effect on attitude towards playing mobile AR games.

The rationale why we propose that physical activity of gaming is proposed to a positive evaluation is grounded in neuroscience (e.g., [Ho12]). Neuroscientists have identified two main reasons why physical exercise makes people feel better: First, human evolution has linked physical exercise to stress, such as hunting or fighting enemies. To cope this stress, the human brain releases the so called BDNF protein which acts like a reset factor [Sw11]. Second, physical activities often lead to a release of endorphins. These neuropeptides lead to a feeling of euphoria, also known as ‘runners high’. Recent research shows positive short-term effects of playing Pokémon Go on users’ level of activity. Thus:

H2: Activity has a positive effect on attitude towards playing mobile AR games.

Flow theory, proposed by Csikszentmihalyi [Cs75], explains the phenomenon of optimal experiences. Flow is defined as “the holistic experience that people feel when they act with total involvement” [Cs75] and represents a predominantly hedonically characterized gratification [GP09]. When people experience flow, they become absorbed in their activity in a way that their awareness is narrowed to the activity itself. Finally, people usually perceive flow as something intrinsically rewarding, i.e. positive [SL13].



In order to achieve a flow experience, several conditions need to be fulfilled [Sc13, Cs75]. First, users need to have a clear understanding of what and how to play an AR game. An additional condition is to get feedback about one's performance while conducting a task. AR games usually present a user's scores or even high score lists. In situations where navigation is needed, Schaffer [Sc13] argues that knowing where to go is required. AR apps are based on a navigation to particular areas. Finally, as stated in the early work of flow [Cs75], flow requires a good balance between the task's challenges and the user's skills when performing a task.

While the above cited studies are examples of the widely replicated finding of the driving force of flow, we propose that flow is related to all three reaction variables in our model: First, replicating Hsu and Lu [HL04], we propose that flow has a positive effect on the attitude towards using mobile AR games (H3a) and the intention to continue playing them (H3b). In addition, we propose that flow also drives in-app purchases (H3c). This is because in-app purchases can enable the management of difficulty in a game. Prior research has shown that people are motivated to maintain the flow experience by proactively managing flow [Sc13]. Csikszentmihályi [Cs75] stated that in situations where challenges are too low, people get back to flow by increasing them. In gaming, this means that gamers reach a more difficult 'level'. In many gaming apps with a freemium business model, users can also reduce challenges by buying certain in-game items they were not able to reach themselves. Therefore, we propose that in order to maintain flow experience, people tend to engage in in-app purchases.

H3a: Flow has a positive effect on attitude towards playing mobile AR games.

H3b: Flow has a positive effect on intentions to continue playing mobile AR games.

H3c: Flow has a positive effect on mobile AR game in-app purchase intentions.

In consumers' mind, long-term knowledge about anything is stored in associated networks [Fa86]. These associations are highly subjective, and people use these associations to create an overall evaluation of an item.

Human's long-term knowledge is also biased in a way that people tend to forget negative experience and overrate positive experiences. In research, this effect is termed the "Rosy view" [Mi97]. In line with this, the branding literature shows that many people value particular brands because that are linked to certain traditions (e.g., [St08]).

We propose that playing games is something that most people started experiencing when they were children. That is, playing a game might activate associations from the 'good old days' [Fa86], which are according to the rosy view predominantly positive [Mi97]. Thus, our research model proposes that the more a game activates nostalgic associations, the more positive a consumer should react to it. So called retro games (e.g. Space Invaders or Tetris) also make articular use of this. Thus, we propose:

H4: Nostalgia has a positive effect on attitude towards playing mobile AR games

It is a widely replicated finding among U&GT scholars that social integrative motivations (i.e. the motivation to improve one's social relationships) are a fundamental driver of media choice and use [Ru00]. For instance, social media such as Facebook help people connect with other people [Sh08, Ro16]. With regards to mobile AR games, we propose that social benefits, defined as the perceived benefits of creating new and maintaining existing social relationships through the use of a mobile AR app, drive the acceptance of the app.

Playing AR games might help users get in touch with other gamers. On the one hand, many games have online communities – similar to brand communities – in which users discuss game related and other topics. Probably more importantly, playing mobile AR games is highly visible to others. If people with similar interests get in touch while engaging in similar activities (i.e. playing the same game), it is likely that this leads to social interactions and form the basis for new relationships.

While the aforementioned section focused on creating new relationships, people can play mobile AR games with friends. As strong and close relationships with friends are something people usually desire and aim to manage with media [Ka73, Ru02], we propose that this factor drives the attitude towards using Pokémon Go. Moreover, we propose that this effect should also directly relate to the intention to continue playing a mobile AR games. Therefore, we propose the following:

H5a: Socializing is positively related to attitude.

H5b: Socializing is positively related to intention to continue using.

We define image as the degree to which an individual perceives that playing a mobile AR game will enhance his or her status in his or her social system [MB91]. We propose that this widely replicated finding is also relevant in the context of mobile AR games. Similar findings have been reported in the literature on brands, where people judge other people based on the brands they are using [EB03, St08]. Therefore, we propose that the perceived image of playing a particular mobile AR game directly transfers into the three dependent variables: First, people have a general preference for things that have a good image (H6a). Second, even if people do not like something (e.g. a product), they might still adopt it, if it has a positive image (H6b). Finally, if a mobile AR game has a good image, people might use it more intensely and thus might also be more motivated to achieve better results – in-app purchases might be beneficial in this case (H6c).

H6a: Image has a positive effect on intentions to attitude playing mobile AR games.

H6b: Image has a positive effect on intentions to continue playing mobile AR games.

H6c: Image has a positive effect on in-app purchase intentions.

Social norms are defined as the extent to which an individual believes that other people expect him or her to use a specific mobile AR game. According to Hsu and Lu [HL04], a large number of studies confirmed that social norms positively influence the use of technology and media. Thus, we hypothesize:

H7a: Social Norms have a positive effect on intentions to continue playing mobile AR games.

H7b: Social Norms have a positive effect on in-app purchase intentions.

### 3.2 Risks

Physical risk involves the “potential threat to an individual’s safety, physical health and wellbeing” [Lu05]. Mobile AR gaming is distinct in terms of fully immersing its users while being in the normal environment. Therefore, it is not surprising that Sharma and Vassiliou [SV16] reported serious road traffic accidents because of Pokémon Go which people want to avoid. Thus:

H8: Physical Risk has a negative effect on attitude towards playing mobile AR games.

Information and media technology can pose threats to individual privacy, especially since users often pay for the use with personal information (e.g. Facebook) rather than with money [Co95]. As media and technologies become increasingly personal and ubiquitous, privacy concerns are growing in importance [Ac04]. Against this background, many scholars conceptualize privacy concerns as a risk factor that reflects an individual’s inherent worries about possible his or her loss of personal information from using a particular media or technology [Ma04]. Because a user’s perception of a media or technology’s privacy concerns reduces its perceived trustworthiness, privacy concerns are linked to a psychological barrier of risk, involving vulnerability [BH94] and uncertainty [LW85], two antecedents to decrease the adoption of media and technology, thus:

H9: Privacy Risk has a negative effect on attitude towards playing mobile AR games.

### 3.3 Relationship between the endogenous variables

We propose that the attitude towards using mobile AR games is positively related to the intention to use a game [KH06]. Thus, we propose:

H10a: Attitude towards using has a positive effect on intention continue playing AR games.

H10b: Attitude towards using has a positive effect on intention in-app purchases.

H11: The intention to continue playing AR games is positively correlated with the intention to conduct in-app purchases.

### 3.4 Control variables

We also included several control variables in our model. First, as the amount of

knowledge consumers have about mobile AR games, we included familiarity with the studied game (Pokémon Go) as a control variable, as well two common demographic variables, age and gender.

## 4 Methodology and Research Design

We applied survey methodology to analyze the proposed model. Prior to data collection, we conducted a qualitative pre-study with 18 Pokémon Go users in Germany. The objective of this pre study was twofold. First, we aimed at ensuring that survey items were correctly understood by respondents. Second, we wanted to ensure that no relevant other constructs were missing in the questionnaire. This pre-study lead to some minor revisions on the wording. With the help of a professional market research firm, we surveyed 642 German respondents who reported having installed Pokémon Go on a mobile device.

If possible, we adopted established scales to the research context. We used seven point Likert scales (1=totally disagree;7=totally agree). The appendix provides an overview of the final measurement model. An inspection of the overall CFA indicates good psychometric characteristics ( $\chi^2=1371$ ,  $df=.624$ ;  $p<.001$ ; CFI=.972, NFI=.966, RMSEA=.043, SRMR=.043). In addition, on a construct level, all C.R., Cronbach's Alphas and AVE exceeded the established minimums of .7, .7., and .5, respectively. Correlations and descriptive statistics are available on request. Tests for common method bias and discriminant validity did not indicate any concerns.

## 5 Results

After having established the measurement model, we modelled the structural equation model using a Maximum Likelihood Estimator in Mplus 7.2 [MM13]. All fit measures were in line with the recommendations from the literature ( $\chi^2=1556.25$ ,  $df=708$ ,  $p<.001$ ; CFI=.968; NFI=.963; RMSEA=.043; SRMR=.048).

Attitude towards playing Pokémon Go is driven by enjoyment ( $\beta_{H1}=.52$ ;  $p<.001$ ), activity ( $\beta_{H2}=.14$ ;  $p<.01$ ), flow ( $\beta_{H3a}=.11$ ;  $p<.01$ ), nostalgia ( $\beta_{H4}=.08$ ;  $p<.01$ ), and image ( $\beta_{H6a}=.15$ ;  $p<.01$ ). In addition, higher levels of physical risks relate to lower attitudes towards playing Pokémon Go ( $\beta_{H8}=-.06$ ;  $p=.04$ ). Thus, the results support H1, H2, H3a, H4, H6a and H8. No significant effects were found for socializing ( $\beta_{H5a}=-.07$ ;  $p=.27$ ) and privacy risks ( $\beta_{H9}=-.04$ ;  $p=.18$ ), rejecting H5a and H9. The control variables show significant effects on attitude variable (familiarity with the game:  $\beta=.07$ ;  $p=.04$ ; age:  $\beta=.08$ ;  $p<.01$ ; gender:  $\beta=.09$ ;  $p<.01$ ). All of these variables together explain 62.4% of the attitude's variance.

The model also identifies factors that relate to the intention to continue playing Pokémon Go: In line with the technology acceptance literature, attitude towards using Pokémon Go ( $\beta_{H10a}=.58$ ;  $p<.001$ ) relates to higher levels of continued use, supporting H10a. In addition, flow ( $\beta_{H3b}=.09$ ;  $p=.02$ ), image ( $\beta_{H6b}=.11$ ;  $p=.08$ ) and norms ( $\beta_{H7a}=.11$ ;  $p<.10$ ) show (partially) significant effects, whereas we did not find this effect for social benefits ( $\beta_{H5b}=.01$ ;  $p=.86$ ). Results are also weakly influenced by the control variables (familiarity with the game:  $\beta=.08$ ;  $p<.01$ ; age:  $\beta=.16$ ;  $p<.001$ ; gender:  $\beta=.03$ ;  $p=.33$ ). All of these variables together explain 68.5% of the intention's variance.

Finally, results provide insights into the factors that drive the intention to spend money in in-app purchases. This target construct is driven by flow ( $\beta_{H3c}=.11$ ;  $p=.02$ ), norms ( $\beta_{H7b}=.28$ ;  $p<.01$ ), and image ( $\beta_{H6c}=.25$ ;  $p<.01$ ), supporting H3C, H7b and H6c. Surprisingly, no significant effect was found for attitude towards using Pokémon Go ( $\beta_{H10b}=.05$ ;  $p=.30$ ), rejecting H10b. In addition, some of the control variables weakly influence the in-app purchase variable (familiarity:  $\beta=.05$ ;  $p=.225$ ); age:  $\beta=.08$ ;  $p=.01$ ; gender:  $\beta=.03$ ;  $p=.33$ ). All of these variables together explain 40.2% of variation. Finally, we investigated the relationship between intention to play Pokémon Go and In-app purchases. In support with H11, these two constructs are correlated ( $r_{H11}=.24$ ;  $p<.001$ ).

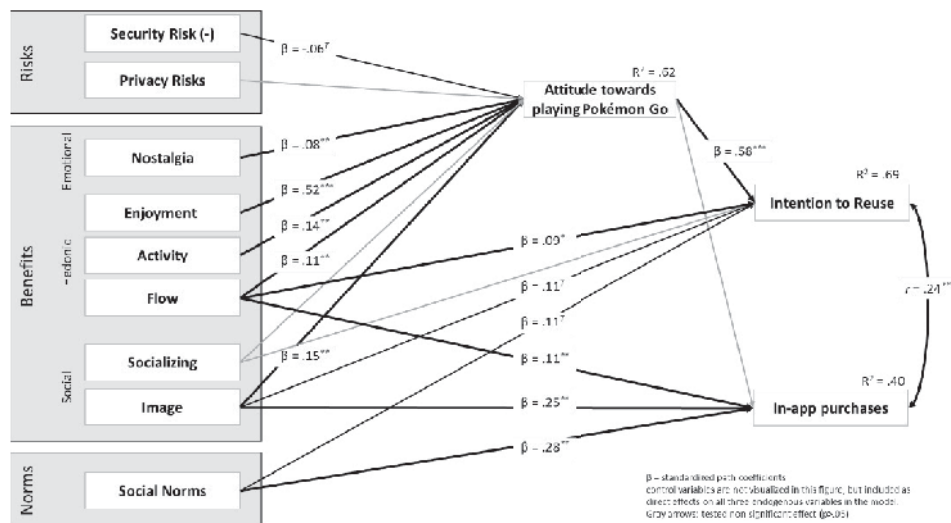


Fig. 2: Results

## 6 Discussion

As discussed, mobile AR games, such as Pokémon Go, have recently received attention. However, not much research has been done to investigate how and why consumers use

these games, and in addition, existing media and technology theories do not capture the specific characteristics of this new form of gaming apps sufficiently. To address this crucial research gap, we developed a theoretical framework grounded in the literature on technology and media use, and supplemented it with additional findings related research streams by incorporating the characteristics of mobile AR games. We then tested the model in an empirical study using the example of Pokémon Go. The effects identified for the investigated benefits are in line with those reported in prior research from related applications (e.g., [HL04]). In particular, the current study shows that consumers' attitude towards playing mobile AR games is mostly driven by the level of enjoyment and the image that playing a particular game has on other people. In addition, also nostalgic emotions, the flow experience, and the physical activity from playing contribute to a positive association. However, the risk of being injured or hurt while playing decreased this attitude. In addition, gamers' intention to continue playing a game is driven by their attitude towards playing it, and by the flow experience [HL04]. Surprisingly, although playing mobile AR games is a highly social activity, socializing was not found to be related to any of the target variables. Finally, we also investigate the intention to conduct in-app purchases. Findings support that in-app purchases are driven by social norms, image, and flow; however, findings did not support attitude towards playing the game as a driver of in-app purchases. This counter-intuitive finding is surprising, as it means that spending money in in-app shops is not particularly linked to a better attitude towards the game.

As any research, this study has some limitations. First of all, this study was conducted among users of mobile AR games. That is, this study identified variations in the constructs among users, but not among non-users. Therefore, factors driving the general interest in these games (i.e., whether they install and try these apps or not) remains an avenue for further research.

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